REMARKS/ARGUMENTS:

Minor changes are made to the specification. Support for the changes to the specification can be found in Figure 1. Claims 1-8, 11, 12, 15, 18, 19, and 25 are amended. Claims 9 and 10 are canceled without prejudice. Claims 1-8 and 11-25 are pending in the application. Reexamination and reconsideration of the application, as amended, are respectfully requested.

The present invention relates to a polyimide film that can be suitably used as an electronic material for a flexible printed circuit board, a base film for use in semiconductor packages such as a COF (Chip On Film: semiconductor devices are packaged directly on printed wiring board), a TAB (Tape Automated Bonding) tape, a base film for use in a high density recording medium, a laminate having a metal layer and a polyimide film by using PVD (Physical Vapor Deposition) methods, and the like. The PVD methods include thermal evaporation, electron beam deposition, inductive and/or resistive deposition, ion plating, sputtering, plasma-activated evaporation, reactive evaporation, and activated reactive evaporation, and chemical vapor deposition (CVD). More specifically, the present invention relates to a polyimide film having a low thermal shrinkage rate at a temperature of 300°C, more particularly to a polyimide film having not only a low thermal shrinkage rate at a temperature of 300°C, but also a low coefficient of hygroscopic expansion and water absorption percentage (water absorption in percentage of total weight). (Applicant's specification, at p. 1, first paragraph).

Moreover, the present invention relates to a polyimide film that is very suitable for alkali etching process, and highly stable against harsh environment. More particularly, the present invention relates to a polyimide film that shows a high peel strength in an interface with a metal layer directly laminated thereon, and that retains, with a high retention rates, the peel strength after thermal aging process and after harsh environmental exposure. (Applicant's specification, at p. 2, first full paragraph).

Further, the present invention relates to laminate having a metal layer and a polyimide film in which metal layer is formed on the polyimide film. (Applicant's specification, at p. 2, second full paragraph).

CLAIM REJECTIONS UNDER 35 U.S.C § 112:

Claims 2-7 and 10-25 stand rejected under 37 C.F.R § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. This rejection is moot with respect to claim 10 due to the cancellation of this claim. The Applicant respectfully traverses this rejection as to claims 2-7 and 11-25.

The Office states that the claims are indefinite because of the occurrences of phrases beginning with the word "where" placed within parentheses. In response, the Applicant deleted the parentheses from the phrases beginning with the word "where". Withdrawal of this rejection is thus respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. § 102:

Claims 1-4, 7-14, 17-24 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Akahori et al., U.S. Patent No. 5,081,229. This rejection is moot with respect to claims 9 and 10 due to the cancellation of these claims. The Applicant respectfully traverses this rejection as to claims 1-4, 7, 8, 11-14, and 17-24.

Claim 1

The Office first asserts that:

(i) Akahori discloses a laminate of a metal layer and a polyimide film;

(ii) Akahori describes a polyimide film obtained by copolymerization of an acid dianhydride component including a pyromellitic dianhydride and a biphenyl tetracarboxylic dianhydride and a diamine component including a diaminodiphenyl ether and a paraphenylene diamine; and

(iii) the acid dianhydride component includes 50% or more pyromellitic dianhydride. The diamine component includes 20-80% of diaminodiphenyl ether and/ or paraphenylene diamine. The molar ratio of the diaminodiphenyl ether to paraphenylene diamine is 1/4 to 4.

Then, the Office further states that Akahori describes a polyimide film of the same chemical composition as claims 1-4, 7-14, 17-24. As to the dynamic viscoelasticity and other specific properties, the Office acknowledges that Akahori gives no description of these physical properties, yet sees that the physical properties, if measured, would fall in a range that defines the present application.

Akahori does describe a composition of the polyimide film: an acid dianhydride component including a pyromellitic dianhydride and a biphenyl tetracarboxylic dianhydride and a diamine component including a diaminodiphenyl ether and a paraphenylene diamine. However, Akahori describes the composition

and the ratios of the components in general terms. Akahori is silent about the tanδ peak temperature of a manufactured polyimide film or actual measurements of the tanδ at 300°C. Moreover, the tanδ peak temperature of a polyimide film and the tanδ value at 300°C as recited in claim 1 is not determined solely by the composition of the polyimide film. The Applicant respectfully submits that the conclusion that the polyimide film of Akahori inherently has the tanδ peak temperature and the tanδ value at 300°C recited in claim 1 on the grounds that Akahori discloses a polyimide film having the same chemical composition as recited in the present application is incorrect.

Applicant has verified that the Akahori polyimide film lacks the tanδ peak and the tanδ value at 300°C recited in claim 1. In order to support this assertion, the Applicant submits herewith a Declaration under 37 C.F.R. § 1.132 of inventor Kan Fujihara. Please refer to the comparative experiment data in Table 1. The data demonstrate that the laminate of claim 1 has novelty over Akahori. Consideration of the Declaration of Kan Fujihara is respectfully requested.

Further, Akahori is completely silent about the design concept of a polyimide film that thermal shrinkage at high temperatures decreases if the polyimide film has a dynamic viscoelasticity whose tanδ peaks at 310 to 410°C and is 0.05 at 300°C. The invention as defined in claim 1 is achieved based on a discovery of this unexpected fact that the thermal shrinkage ratio is related with the tanδ peak temperature range and the tanδ value at 300°C. The change of subject matter in the claims is intended to emphasize these features of the claimed polyimide film that the film meets conditions on the tanδ peak temperature range and the tanδ value at 300°C.

The laminate containing a metal layer formed directly on a polyimide film allows for a thin metal layer, therefore suitable for the formation of fine wiring.

However, if the polyimide film in such a laminate has a high thermal shrinkage and fabricated into fine wiring, the film (fine wiring) shrinks due to heat, resulting in the wire intervals deviating from designed values This may cause failed wire-to-wire connection. The reduced intervals may bring wires in contact with each other where no such a contact is intended, leading to short circuits. Further, the stress caused by the shrunk film may cause the wires to fall off. For these reasons, if the polyimide film of the invention is used in a laminate containing a metal layer formed directly on a polyimide film in the fabrication of fine wiring, the film achieves remarkable effects.

These effects are evident when a metal layer is formed directly on the polyimide film as described in the specification at page 61, *Laminate having a Metal Layer and the Polyimide Film*.

Thus, Akahori does not anticipate claim 1. Akahori gives no description at all about the tanδ peak temperature of a polyimide film and the tanδ value at 300°C, not to mention the correlation between these properties and the thermal shrinkage ratio. In contrast, the present invention has discovered that a polyimide film shows a low thermal shrinkage ratio if its tanδ peaks at 310 to 410°C and is 0.05 at 300°C and also that the effects are especially evident with a laminate containing a metal layer formed directly on the polyimide film.

In view of the foregoing, Applicant respectfully submits that claim 1 and its dependent claims are novel and nonobvious over the cited reference. Withdrawal of these rejections is thus respectfully requested.

Claim 11

Claim 11 claims a polyimide film with the following features: It is obtained by copolymerization of a diamine component and a dianhydride component containing a biphenyl tetracarboxylic dianhydride and a pyromellitic dianhydride.

Its etching speed in a 1-N potassium hydroxide solution is 0.1 μm/minute or higher for one side of the film. In contrast, Akahori is silent about a polyimide film which is obtained by copolymerization of a biphenyl tetracarboxylic dianhydride and a pyromellitic dianhydride and whose alkali etching speed is 0.1 μm/minute or higher. Akahori only mentions that biphenyl tetracarboxylic dianhydride may be used together as an acid dianhydride. Akahori is silent about actual fabrication of a film involving a biphenyl tetracarboxylic dianhydride. Applicant has verified through experiment that the Akahori polyimide film does not meet the alkali etching property recited in claim 11. Please refer to the comparative experiment data in Table 1. The data demonstrates that the polyimide film of claim 11 is novel over Akahori.

Conventional polyimide films become less stable under harsh environmental conditions if the alkali etching property is improved. Conversely, the polyimide film of claim 11 inherently has long-term stability under harsh environmental conditions despite high alkali etching speed. Alkali etching speed could not be improved with conventional polyimide films in an alkali etching solution having an alkali concentration as low as a 1-N aqueous solution of potassium hydroxide. The Applicant has found that the polyimide film exhibits an excellent alkali etching property if the film contains a bis(trimellitic monoester anhydride) is added as a polymerization component for example. In addition, the Applicant has found that those films with the good alkali etching property show poor stability over time under harsh conditions (high temperature and high humidity). Both alkali etching and degradation at high temperature/high humidity occurs through the same mechanism, i.e., hydrolysis. It is extremely difficult to improve both the alkali etching property and the long-term stability under harsh conditions (high temperature and high humidity). Therefore, the Applicant believes that no

polyimide film has ever been found so far which displays these conflicting features. In other words, no film has ever achieved both improved alkali etching speed in an alkali etching solution with a low alkali concentration and an excellent stability to environmental conditions. The Applicant has conducted research for a polyimide film with a good alkali etching property and found that the addition of a biphenyl tetracarboxylic dianhydride in polymerization of polyimide improves the film's environmental stability. The Applicant has further discovered that the environmental stability and the alkali etching property are both enhanced by polymerizing a biphenyl tetracarboxylic dianhydride to a pyromellitic dianhydride and further copolymerizing a bis(trimellitic monoester anhydride) for example. Due to this novel finding, the Applicant successfully obtained the polyimide film with improved alkali etching speed and excellent environmental stability. The finding is not at all taught or suggested by Akahori. Therefore, claim 11 is not obvious over Akahori.

The polyimide film of claim 11 and its dependent claims and the laminate of claim 18 containing a polyimide film of the same structure as claim 11 are similarly novel and nonobvious over the cited reference. Withdrawal of these rejections is thus respectfully requested.

Claim 19

Akahori must involve diaminodiphenyl ether and paraphenylene diamine. As an acid dianhydride, pyromellitic dianhydride or biphenyl tetracarboxylic dianhydride may be used. However, Akahori is silent about use of a bis(trimellitic acid anhydride). Consequently, Akahori is similarly silent about the manufacture of a polyimide film involving all these five components at a particular ratio (the five components are a diaminodiphenyl ether, a paraphenylene diamine, a pyromellitic

dianhydride, a biphenyl tetracarboxylic dianhydride, and a bis(trimellitic acid anhydride)).

In contrast, Tanaka describes a polyimide film comprising four components: paraphenylene bis(trimellitic acid anhydride), oxydiphthalic dianhydride, paraphenylene diamine, and diaminodiphenyl ether. Tanaka however is silent about use of a biphenyl tetracarboxylic dianhydride. Consequently, Tanaka is similarly silent about the manufacture of a polyimide film involving all the foregoing five components (a diaminodiphenyl ether, a paraphenylene diamine, a pyromellitic dianhydride, a biphenyl tetracarboxylic dianhydride. and a bis(trimellitic acid anhydride)) at a particular ratio.

In addition, both cited references are completely silent about the initial peel strength of a polyimide film produced from a monomer containing the five components (a diaminodiphenyl ether, a paraphenylene diamine, a pyromellitic dianhydride, a biphenyl tetracarboxylic dianhydride, and a bis(trimellitic acid anhydride)) at a particular ratio. Consequently, both Akahori and Tanaka fail to mention that such a polyimide film shows an extremely good retention rate of the peel strength after environmental experiment. Therefore, claim 19 can neither be anticipated nor rendered obvious over these cited references.

It is known that environmental experiment will show that the interface between the polyimide film and a copper layer degrades due to oxidation of the metal layer or migration of the metal to the polyimide film for example (Please refer to Exhibit B which is document 1: Mat. Res. Soc. Symp. Proc. Vol. 131. p603, 1989 Materials Research Society, which is submitted concurrently herewith). The interface degradation in turn causes large drops in adhesion strength between the polyimide film and the metal layer in the laminate. Retaining peel strength after environmental experiment is therefore a very challenging issue. Claim 19 has

successfully provided a solution to this difficult issue by manufacturing a polyimide from the five components (a diaminodiphenyl ether, a paraphenylene diamine, a pyromellitic dianhydride, a biphenyl tetracarboxylic dianhydride, a bis(trimellitic acid anhydride)) at a particular ratio. This fact further demonstrates that claim 19 is nonobvious over both of the cited references.

Thus, claim 19 and its dependent claims are novel and nonobvious over the cited references. Further, the laminate of claim 25 containing a polyimide film of the same structure as claim 19 is similarly novel and nonobvious over the cited references. Withdrawal of these rejections is thus respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. § 103:

Claims 5-7, 15, 16, and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Akahori as applied to claims 1-4, 7-14, 17-24 above, and further in view of Tanaka (JP 2000-297163). The Applicant respectfully traverses this rejection.

Claims 5-7 and 15-16 depend from claims 1 and 11, respectively and are therefore, patentable over the cited references for at least the same reasons discussed above. Claim 25 is similarly patentable over the cited references for the reasons discussed above. Withdrawal of these rejections is thus respectfully requested.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number

(213) 337-6700 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,
HOGAN & HARTSON L.L.P.

Date: August 2, 2005

By: _____
Dariush G. Adli
Registration No. 51,386
Attorney for Applicant(s)

500 South Grand Avenue, Suite 1900
Los Angeles, California 90071
Phone: 213-337-6700
Fax: 213-337-6701